Energy Uses/Limits

Activity 4: How Long Will It Last?--Part I

Activity 5: How Long Will It Last?--Part II

Activity 6: Now You’re Cooking

Activity 4 **HOW LONG WILL IT LAST? - PART I**

CONCEPT Many energy resources are unevenly distributed and have limits to their usefulness.

GOAL Students will demonstrate through a simulation activity that coal is deposited unevenly between the earth's surface and underground, and will observe the limits of several energy sources.

MATERIALS Items listed in bold type must be supplied by the teacher. Per student: chocolate chip cookie, paper clip and napkin, another cookie (optional)

ACTIVITY

INVITE/PRESENT PROBLEM

1. Give each student a cookie, paper clip, and napkin. Be sure they don't begin to eat it!

2. Tell students that the cookie represents the state of Colorado. The tan area represents the earth's crust and the chocolate chips represent the coal deposits. They are going to "mine" the cookie.

EXPLORE/GATHER INFORMATION

3. Instruct students to count the number of visible chunks of coal in Colorado. Count only the coal deposits visible from the top. Record class data on the chalkboard.

4. Have students make a prediction as to how many coal deposits (chocolate chips) will exist in their mine. Record these predictions as well.

Student Name/Mine Name	**Number of Surface Deposits**	**Predicted # of Total Deposits**	**Actual # of Deposits**

5. Have students use their paper clip to begin "mining" their coal deposits. Place the coal deposits in one pile and the earth's crust in another pile. Have students count the coal deposits and record the class data on the chalkboard.

6. Compare and contrast the number of coal deposits visibly observed and actually in existence. How does the actual number of coal deposits compare to their predictions?

PROPOSE EXPLANATIONS

7. Discuss the following points with the class:

A. There were more "coal deposits" than could be seen on the surface.

B. Mining the deeper coal took more time, energy and was more trouble than mining the coal near the surface. This means that it often takes energy to get usable energy. Explain to students that the machinery and trucks used to mine coal use gasoline/diesel fuel to operate. Thus, we must *use* energy (gas) to get energy (coal).

C. Mining the coal disturbs the earth's crust. This means mining coal has environmental impacts. Have students look at the mess of crumbs on their napkin to illustrate this point.

D. Coal deposits were unevenly distributed. This means some students had more coal deposits than others.

APPLY NEW KNOWLEDGE

E. Show the students a Colorado map of coal deposits which illustrates that some areas have more coal deposits than others. Ask students to identify where the Rocky Mountains would be placed on the map. Do most of Colorado's coal deposits lie to the east or west of the mountain range? Are their coal deposits in the county in which you live? Use a colored marking pen to color areas where a lot of people live. What are some problems with this?

PRESENT FINDINGS, ASK NEW QUESTIONS

8. Summarize with students that energy sources are unevenly distributed, it takes energy to obtain energy, and securing an energy source affects the environment.

9. Have students do another cookie where they can eat the chips once they are mined but they must put back the rest of the cookie. This models reclamation efforts that are required once mining has been completed. You can discuss the replacement of vegetation and wildlife. (Where does the wildlife go while the area is being mined?)

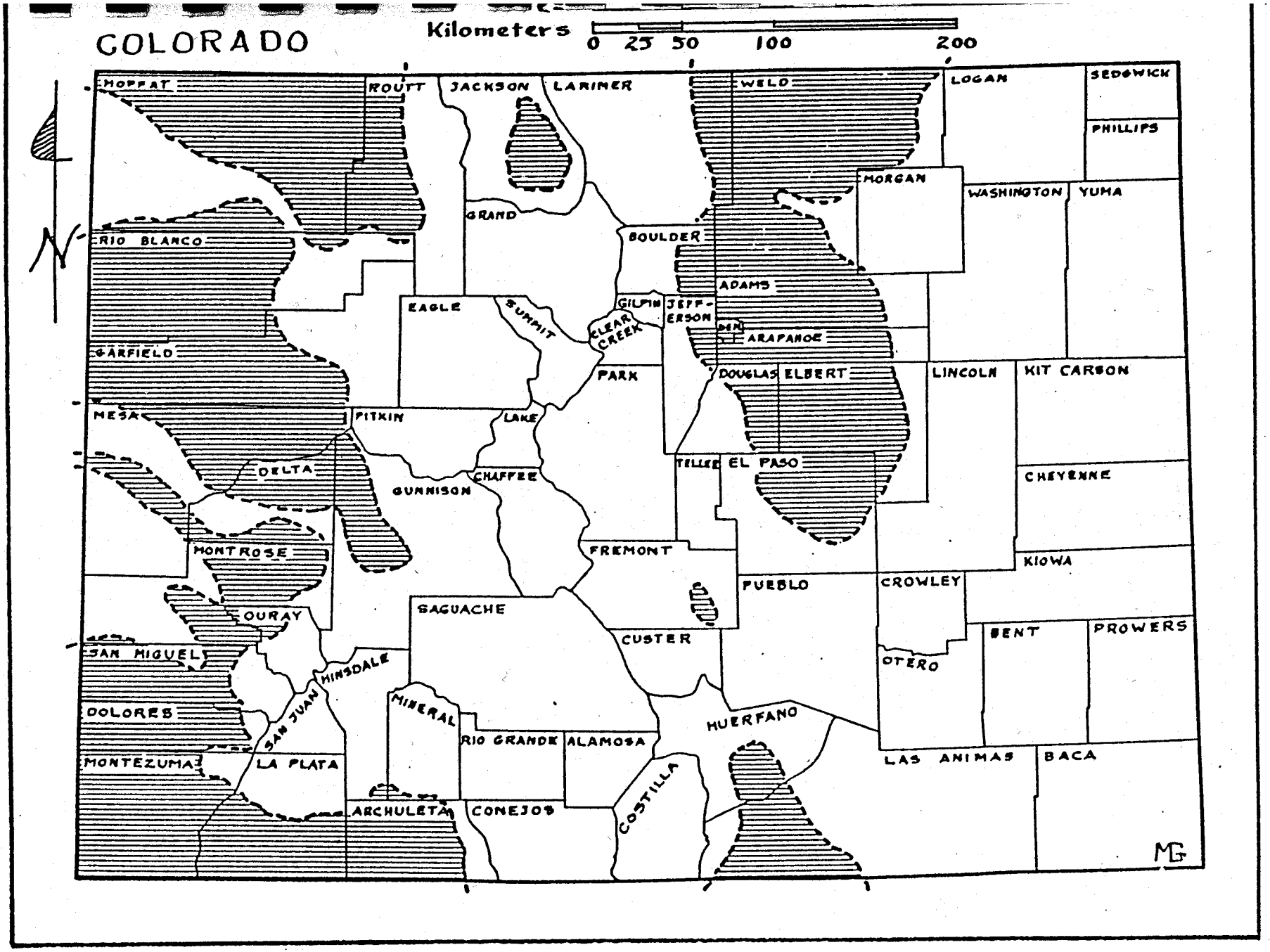


FIGURE 5.9. Areas underlaid by coal-bearing strata. No differentiation is made as to type of coal or depth of coal deposit below the surface. (Source: U.S. Geological Survey and Colorado Geological Survey, *Energy Resources Map of Colorado, 1977:1979,* Miscellaneous Investigations Series, map

Activity 5 **HOW LONG WILL IT LAST? - PART II**

CONCEPT All energy resources have limits to their usefulness.

GOAL Students will observe the limits of several energy sources.

MATERIALS Items listed in bold type must be supplied by the teacher. Flashlight, battery, birthday candles, matches, **candy packet for each student (Nerds)**

ACTIVITY

INVITE

1. Ask students to name some sources of energy (review).Get them started by suggesting the Sun. Other examples should include items that *make* energy: flashlight, candle, food, wood, etc.

EXPLORE

2. Put the following data chart on the board or overhead to use in the following activities:

Guess/Test/Tell

Item Being Tested	**Hours**			**Days**		
	Guess	*Test*	*Tell*	*Guess*	*Test*	*Tell*
Flashlight						
Candle						
Candy Packet						

3. **Flashlight Energy (Electricity)**. Turn the flashlight on and leave it on until the energy is used up (8-36 hours). Have students predict how long they think the energy in the batteries will last. Relate this study to the fact that the electrical energy in the battery will last only a certain amount of time. The energy is limited.

Extension: Test several brands of batteries. Be sure they have the same "expiration" date!

4. **Candle Energy**. Using a small birthday candle, have students predict how long the candle will burn, giving off heat and light energy. Again, relate this study to the idea that energy stored in the candle (chemical energy from oil) will last only a certain amount of time. The energy is limited.

5. **Food Energy**. Distribute the candy packets to each student. Tell them to eat them, but to conserve them as much as possible to make them last for several days. At certain times during the day, have students eat a few pieces. Relate this activity to the fact that food energy of the sugar is limited. It will last only so long. This is why we eat three meals each day - to extract the energy from food.

PROPOSE EXPLANATIONS/PRESENT FINDINGS

6. Have students go back and look at the data table. Ask "which energy source lasted the longest?" "What is the limit to the usefulness of a candle?" "Is there a limit to how much food you can eat?" "Which of these sources could 'last forever?'"

7. Discuss the meaning of the word "limited" using the experiences the students have had with the activities. Related "limited" to energy resources, such as coal, oil, and natural gas. Also discuss what is a renewable resource, e.g., wood, water, sun, wind. In what ways **aren't they limited** like nonrenewable resources? In what ways **are they limited** like nonrenewable resources? For example, the sun’s energy is not very useful when the sun isn't shining.

Guess/Test/Tell

Item Tested	Hours			Days		
	Guess	Test	Tell	Guess	Test	Tell
Flashlight						
Candle						
Candy Packet						

Activity 6 **NOW YOU'RE COOKING! (*This activity works best in early fall or late spring. Have students bring in boxes and a coat hanger before beginning this activity.)**

CONCEPT Energy sources have limits to their usefulness.

GOAL Students will identify limits associated with these energy sources: candle, magnified sun energy, solar cookers.

MATERIALS Items listed in bold type must be supplied by the teacher. "Now You're Cooking" worksheet for each student or use the worksheet questions as a class discussion, magnifying glass, birthday candles mounted on aluminum pie plates, **clock with a second hand**, **regular sized marshmallows,** toothpicks. SOLAR OVEN: **boxes (paper, produce or book boxes work well), empty oatmeal containers,** "How to Make a Solar Cooker" packet for the teacher, **scissors, tape, glue,** aluminum foil, **knife (for teacher only), coat hanger.**

ACTIVITY *Conduct this activity on a warm sunny day.*
INVITE
1. Tell students they will be experimenting with using renewable and nonrenewable energy sources as they cook marshmallows.

2. Review the safety precautions when working with fire or do as a teacher demonstration.

3. Give each student their worksheet or use as a class discussion.

EXPLORE/DISCOVER
4. Put this chart on the board:

Energy Source	**Predicted Number of Marshmallows that will Cook in 3 Minutes**	**Actual Number of Marshmallows that Cooked in 3 Minutes**
Candle		
Magnifying Glass		
Solar Cooker		

5. Have students guess the number of marshmallows they think they can cook using the candle if only one marshmallow is cooked at a time. Have the students record their guesses on the worksheet (question 1).

6. Ask one student to be a timer and call out the time every 30 seconds.

7. Light the candle. Have students take turns holding a marshmallow on a toothpick near the flame. (Depending on the group and safety requirements, you may want to have more than one candle going so that students have a chance to observe and participate in cooking the marshmallows.) Cook as many marshmallows as possible in 3 minutes.

8. Have students answer questions 2-8 on the worksheet. Discuss their answers as a class.

9. Repeat the experiment using the magnifying glass and the sun to cook the marshmallows. Demonstrate how a magnifying glass can be used to concentrate the sun's rays. (Warn students about the dangers of looking directly at the sun, or of putting their hands under the magnifying glass). Have a student call time every 30 seconds.

10. Students can take turns cooking marshmallows under the magnifying glass. Have students answer questions 10-16 on the worksheet or discuss as a class.

BUILDING A PARABOLIC SOLAR COOKER

11. Divide students into groups of 3 to maximize use of materials. Hand out a copy of solar cooker instructions.

12. Follow directions to construct a solar cooker. When completed, continue the investigation by putting marshmallows on the skewer (coat hanger) and cooking for 3 minutes. TRY TO PICK A SUNNY DAY! Students can compare this type of energy to the candle and magnifier.

PROPOSE EXPLANATIONS

13. Ask students which of the energy sources was nonrenewable/renewable. Reinforce why.

14. Which energy source cooked the most marshmallows? What are advantages and disadvantages of using this energy source?

ASK NEW QUESTIONS

15. Ask students about other limits of other energy sources. What are other ways to cook marshmallows. Are these methods renewable or nonrenewable? What are the limits to using them?

Marshmallow Prediction Chart

Energy Source	Predicted Number of Marshmallow that Will Cook in 3 Minutes	Actual Number of Marshmallows that Cooked in 3 Minutes
Candle		
Magnifying Glass		
Solar Cooker		

Now You're Cooking!

Name _____
Date_____

Using a Candle

1. How many pieces do you think could be cooked by the candle?

2. How many pieces were cooked by the candle?

3. Did the results surprise you? Why or Why not?

4. Can the candle be used again and again?

5. Do candles pollute the air?

6. Are candles quick to cook with?

7. Can you use candles to cook at any time of night or day?

8. Is the candle a renewable or nonrenewable source of energy?

Using the sun

9. How many pieces do you think could be cooked by the sun?

10. How many pieces were cooked by the sun?

11. Did the results surprise you? Why or why not?

12. Can the sun be used again and again?

13. Does the sun pollute the air?

14. Is the sun quick to cook with?

15. Can you use the sun to cook with at any time of day or night?

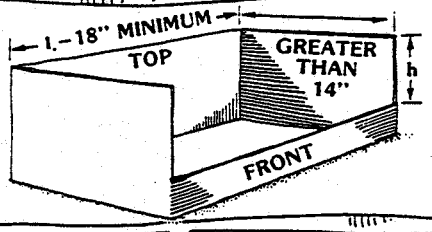
16. Is the sun a renewable or nonrenewable source of energy?

HOW TO MAKE A PARABOLIC SOLAR COOKER

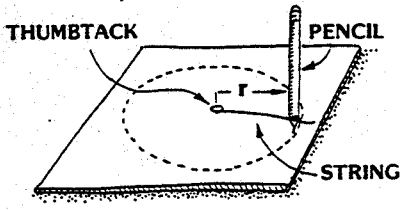
1 Begin with the Frame

You'll need a cardboard box that is strong and in good condition. A long, rectangular box will work better than a short, square one.

Cut the top and front out of the box as shown. The size of this box will determine the size of your cooker.



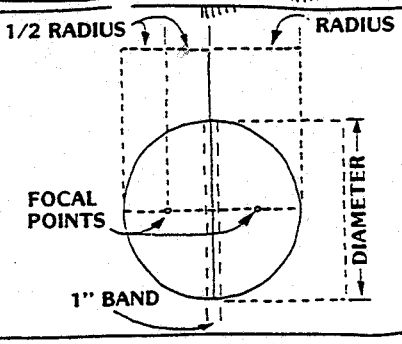
2 Next, the Semi-Circular Ends



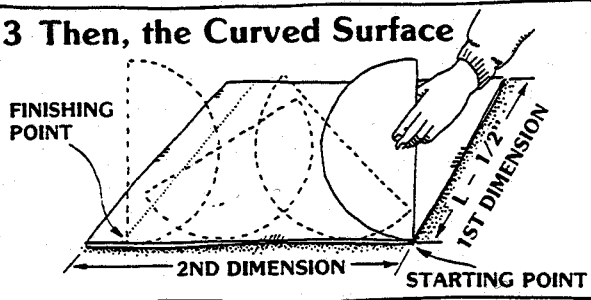
RADIUS (r) = h − 1"

Cut a circle out of cardboard with a radius that is 1" less than the height of the front opening (h) of the frame box.

Locate the focal points as shown and cut out a 1" band, centered along the diameter.



3 Then, the Curved Surface



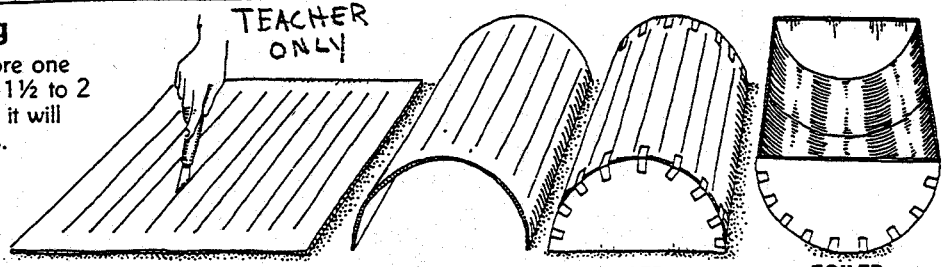
You'll need another piece of cardboard for this part.

The first dimension you need is about 1/2" shorter than the length of the frame (L).

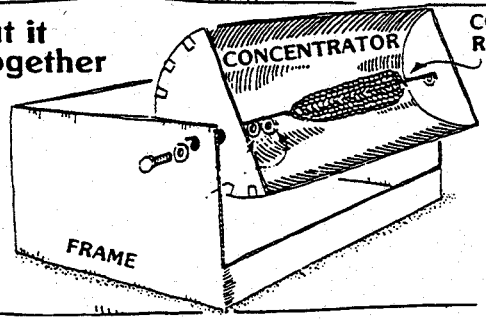
The second dimension is a little more difficult. Start the point of the semi-circular end piece as shown and roll the curved edge along the other unmeasured edge of the cardboard. Be careful not to slip or scoot it. Mark where the other point ends (and maybe add about 1/2"). This distance is your second dimension.

4 Scoring and Taping

After cutting this piece to size, score one side (but don't cut through) every 1½ to 2 inches with lines as shown so that it will bend easily around the end pieces. Tape the end pieces to the curved piece and cover the inside with aluminum foil. Rubber cement works well for htis, just be sure to read directions.



5 Put it Together



Take an unpainted thick wire and hold over a flame to burn off any excess oily substance, then push wire through the focal points of the curved concentrator to make the cooking rod.

HOW TO BUILD A SOLAR BOX COOKER

Supplies Needed:

2 Cardboard boxes (homemade, scavenged or bought).
- Inner box should be at least 15" x 15" (38 cm x 38 cm).
- Outer box should be larger all around, but it doesn't matter how much bigger as long as there is an inch (2.5 cm) or more of airspace between the two boxes. The distance between the two boxes does not have to be equal all the way around.

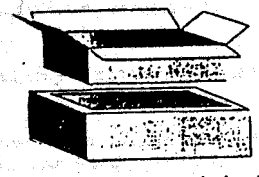
1 8 ounces of white glue or wheat paste
1 small jar of black tempera paint or 1 small black tray (paint it black with non-toxic paint)
1 small roll of aluminum foil
1 oven cooking bag (Reynolds is recommended
Newspaper

Building the Base

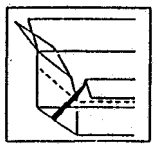
1. Fold the top flaps closed on the outer box and set the inner box on top.

2. Trace a line around it onto the top of the outer box.

3. Remove the inner box and cut along this line to form a hole in the top of the outer box (Figure 1).



4. You can adjust how deep you want your oven to be by slitting the corners of the inner box down to that height. Fold each side down forming extended flaps (Figure 2). Folding is smoother if you first draw a firm line from the end of one cut to the other where the folds are to go.



5. Glue foil to the inside of both boxes and also to the inside of the remaining top flaps of the outer box. The inner box will be visible even after assembly, so you might want to take more time here. Glue the top flaps closed on the outer box.

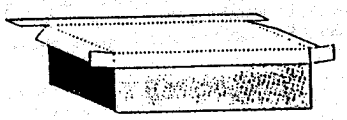
6. Tear up newspaper sheets in fourths and crumple each piece into a lemon sized ball. Place some wads of crumpled newspaper into the outer box so that when you set the inner box down inside the hole in the outer box, the flaps on the inner box touch the top of the outer box (Figure 3). Glue these flaps onto the top of the outer box. Trim the excess flap length to be even with the perimeter of the outer box. The base is now finished.

Building the Lid

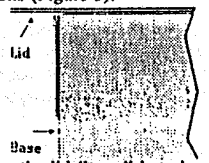
1. Take the large sheet of cardboard and lay it on top of the base.

2. Trace the outline and then cut and fold down the edges to form a lip of about 3" (7.5 cm).

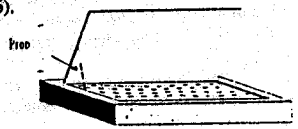
3. Fold the corners around and glue (Figure 4).



4. Orient the corrugations so that they go from left to right as you face the oven. Later the prop may be inserted into the corrugations (Figure 5).

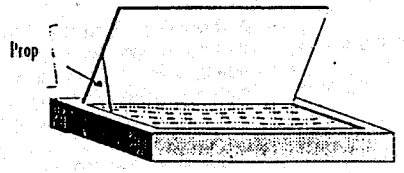


5. One trick you can use to make the lid fit well is to lay the pencil or pen against the side of the box when marking (Figure 6).



6. To make the reflector flap, draw a line on the lid, forming a rectangle the same size as the oven opening.

7. Cut around three sides and fold the resulting flap up framing the reflector (Figure 6) and apply foil to the flap on the inside.



8. To make the prop bend a 12" (30 cm) piece of hanger wire shown in Figure 6. This can then be inserted into the corrugations as shown.

9. Turn the lid upside-down and glue the oven bag in place, without opening it up. This makes a double layer of plastic. The two layers tend to separate form each other to form an airspace as the oven cooks. When using this method, it is important to also glue the bag closed on its open end. This stops water vapor from entering the bag and condensing. Alternately you can cut any size oven bag open to form a flat sheet large enough to cover the oven opening.

10. To make the drip pan, cut a piece of cardboard, the same size as the bottom of the interior of the oven and apply foil to one side.

11. Paint this foiled side black and allow it to dry.

12. Put this in the oven (black side up) and place your pots on it when cooking.

Improving Efficiency

The oven you have built should cook fine during most of the solar season. If you would like to improve the efficiency to be able to cook on more marginal days, you can modify your oven in any or all of the following ways:

1. Make pieces of foiled cardboard the same size as the oven sides and place these in the wall spaces.

2. Make a new reflector the size of the entire lid.

3. Make the drip pan using aluminum flashing and elevate this off the bottom of the oven slightly with small cardboard strips.

Instructions provided by:

Solar Box Cookers Northwest
7036 18th Ave. NE
Seattle, WA 98115 USA
(206) 525-1418

Ready to Cook!!!!

1. Put your food in covered black pots in the solar box cooker with the lid on.
You can use any kind of cookware with solar energy, but dark, lightweight cookware heats up faster. Shiny steel or aluminum pans are less efficient because they reflect heat away from the food. Heavy pottery dishes take longer to heat up, but once hot, it holds the heat better.

2. Aim the box so the shiny side of the lid reflector faces where the sun will be in late morning (lunch) or early afternoon (supper). Tie the prop to hold the lid reflector where it shine the most sunlights into the box.

3. WARNING: Temperatures inside the cooker can reach 300 degrees Fahrenheit. Do not leave the cooker unattended in a place where it could be disturbed by others.

4. Food cooks better:
   - On a warm sunny day in late spring, summer or early fall
   - if you put it towards the back of the box
   - if you adjust the cooker often so that its shadow lies directly behind it
   - if you divide the food up into small pots

5. You need not stir the food while it is cooking. If you open the box during cooking, be careful of the high temperatures inside.

6. Most of all, put the food in early, and don't worry about overcooking, solar cookers seldom overcook.

7. Don't use aluminum foil around your meat or vegetables, or as a cover for a casserole. The aluminum foil will reflect the heat away from the food.

8. How to position the solar cooker. Locate the most sunny and wind-sheltered place in your yard or patio. When you get up in the morning and decide to cook with the sun, think not only of meal planning but also about what kind of solar day it is. If it's exceptionally clear and sunny. Go out and set up you oven and focus it so it will be hot and ready to go when you decide to cook.

9. Perhaps the biggest difference between your kitchen oven and your solar oven is that the heating element of the one in the kitchen stays still, while the sun, which heats your solar oven, is always moving. It moves slowly, but you'll have to remember to move the oven or reflector cooker occasionally to keep the heat where you want it.

10. The morning sun is very low in the sky, so aim your cooker low to catch its rays. The same is true in late afternoon, and sometime before sunset we are done with solar cooking because the sun it too low. Aiming the solar oven and reflector stove is done by watching shadows and is very easy. Observe the sun and see how fast the sun moves and how to adjust the oven for desired temperatures and best results. The oven is pointing directly at the sun.

11. With experience you will be able to aim the cooker to get the best results. If you have a sunny spot available, there can even be snow on the ground as long as the sun is shining brightly. The temperature of a solar cooker is determined more by the amount of sunshine then the outside air temperature.

12. Solar ovens reflect a lot of heat and a great deal of light. You should always wear sunglasses when cooking because of the light intensity. The glasses protect your eyes and make it easier to see inside the oven.